CLAIMS

1. A method for cooling a substrate by means of a refrigerant, which method comprises the following steps:

the refrigerant is compressed in a refrigerating circuit;

the compressed refrigerant is condensed by cooling;

the condensed refrigerant is subjected to an expansion step in order to reduce its pressure and temperature, so that after expansion it is present as boiling liquid and as wet vapor;

boiling liquid and wet vapor are delivered to an evaporator that is in thermal contact with the substrate to be cooled;

refrigerant from the evaporator is subjected once again to the compression step.

2. The method according to claim 1,

wherein the condensed refrigerant is expanded isenthalpically in the expansion step.

3. The method according to claim 1 or 2,

wherein the compressed refrigerant is heated, upon compression thereof, to a temperature (t_2) that is higher than the temperature of a coolant serving to cool it.

4. The method according to claim 3,

wherein ambient air is used as a coolant; and the refrigerant is heated, upon compression thereof, to a temperature (t_2) that is higher than the temperature (t_U) of that ambient air.

5. A cooling arrangement for cooling a substrate such as a semiconductor arrangement, which cooling arrangement is implemented as a cold vapor refrigeration machine in whose refrigerating circuit are arranged a refrigerant compressor (32), a condenser (44) for outputting heat to ambient air, and an evaporator (60), the evaporator being preceded by a throttle valve (62) for isenthalpic expansion of the refrigerant, and the evaporator (60) being implemented as a heat sink for receiving heat from the substrate (12).

6. The cooling arrangement according to claim 5,
wherein the condenser (44) is combined with a fan (20), and with a drive motor (42) for the latter, into one module.

7. The cooling arrangement according to claim 5 or 6,
wherein the circular process of the cold vapor refrigeration machine is a counterclockwise circular process.

8. The cooling arrangement according to one of claims 5 to 7,
wherein the refrigerant in the circuit is present in two phases, namely gaseous and liquid.

9. The cooling arrangement according to one of claims 5 to 8,
wherein the two units, namely the compressor (32) and fan (20), are drivable by the same drive motor (42).

10. The cooling arrangement according to claim 9,
wherein the drive motor (42) drives one of the two units directly, and the other via a magnetic coupling (34).

11. The cooling arrangement according to one of claims 5 to 10,
wherein during operation, the refrigerant is present in the evaporator (60; 60') substantially in the form of a boiling liquid (52a) and saturated refrigerant vapor (52d).

12. The cooling arrangement according to one of claims 5 to 11,
wherein the fan housing (22) and the compressor housing (36) are at least in part combined into one module (40).

13. The cooling arrangement according to claim 12, wherein the module is implemented at least in part as an injection-molded part (40).

14. The cooling arrangement according to claim 13, wherein the injection-molded part (40) is manufactured at least in part from a suitable plastic.

15. The cooling arrangement according to one of claims 5 to 14,
wherein a controller (54) is provided for regulating the temperature (t_V) in the evaporator (60, 60').

16. The cooling arrangement according to claim 15, wherein
the evaporator temperature (t_V) is controllable by modifying the rotation speed of the fan (28) and/or by modifying the rotation speed of the compressor (32).

17. The cooling arrangement according to one of the preceding claims, wherein the evaporator (100) is implemented on the principle of an impact plate.

18. The cooling arrangement according to claim 17, wherein a nozzle arrangement (114) is provided at the entrance point of the refrigerant (52) into the evaporator (100).

19. The cooling arrangement according to claim 18, wherein the nozzle arrangement (114) comprises an orifice nozzle.

20. The cooling arrangement according to Claim 18, wherein the nozzle arrangement (114) comprises a slit nozzle.

21. The cooling arrangement according to one of claims 18 to 20, wherein the nozzle arrangement is implemented to produce a vena contracta.

22. The cooling arrangement according to one of the preceding claims, wherein the heat-transferring surface (114) in the evaporator (100) is implemented concavely on its side facing away from the heat-outputting substrate (106).

23. The cooling arrangement according to claim 22,
wherein the concave surface (114) is implemented approximately in the manner of a spherical shell.

24. The cooling arrangement according to claim 22,
wherein the concave surface (114) is implemented approximately in the manner of a paraboloid of rotation.

25. The cooling arrangement according to one of claims 22 to 24,
wherein heat-exchange elements (116) are arranged on the concave surface (114) with clearances (120) therebetween.

26. The cooling arrangement according to claim 25,
wherein the heat-exchange elements are implemented at least in part in the manner of needles (116).

27. The cooling arrangement according to claim 25 or 26,
wherein there is provided, in the region around the entrance point (114) of the refrigerant (52) into the evaporator (100), at least one obstruction (124) that is effective as an impediment to direct flow of the refrigerant (52) from the inlet (112) to the outlet (126).

28. The cooling arrangement according to one of claims 22 to 27, wherein the part (104) of the evaporator (100) on which the concave surface (114) is provided is implemented as a cold-extruded part made of a thermally conductive material such as copper, aluminum, or silver.

29. The cooling arrangement according to one of the preceding claims, wherein the evaporator (100) comprises an assembly (102) on which the refrigerant inlet (112) and refrigerant outlet (126) are provided.

30. The cooling arrangement according to claim 29, wherein the assembly (102) is implemented as a shaped part made of plastic.

31. The cooling arrangement according to one of the preceding claims, wherein the evaporator (100) is made up of at least two parts (102, 104) that are joined in fluid-tight fashion to one another.

32. The cooling arrangement according to claim 31, wherein an arrangement (140) for mounting the evaporator (100) is integrated into at least one of those parts (102, 104).

33. The cooling arrangement according to claim 31 or 32, wherein the parts (102, 104) are sealed with respect to one another by means of a radial seal (134).